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The Application of the Radiological Defense Capabilities to Peacetime Radiological Incidents

K. S. Gant
M. V. Adler

Interagency Agreement No. DOE 40-680-78
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THIS STUDY DISCUSSES THE APPLICABILITY OF THE NUCLEAR ATTACK COMPONENTS OF THE RADIOLOGICAL DEFENSE (RADEF) SYSTEM, INCLUDING ORGANIZATIONAL STRUCTURES, TRAINING, INSTRUMENTATION, AND SUBSYSTEM CAPABILITIES TO PEACETIME INCIDENTS AND PROPOSES SOME ACTIONS FOR ADDRESSING ALL RADIOLOGICAL HAZARDS WITH THE RADEF SYSTEM.

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ABSTRACT

This paper discusses the applicability of the nuclear attack components of the radiological defense (RADEF) system, including organizational structures, training, instrumentation, and subsystem capabilities, to peacetime incidents and proposes some actions for addressing all hazards with the RADEF system.

Many of the components of RADEF are applicable to peacetime response, but modifications are needed in planning, training, equipment, and titles. Development of the nuclear attack components should be encouraged in all states, but the peacetime response must be more flexible to accommodate the variety of state requirements and organizations. It is suggested that modular training courses be developed to include peacetime radiological response; the modular design will enable the courses to be easily updated. Additional, more flexible, radiation detection equipment would enhance the peacetime usefulness of RADEF (and probably increase the level of training required); the current instrumentation is designed primarily for the high gamma radiation fields expected in a postattack environment. The FEMA-supplied GM survey meter intended for training purposes is being used in emergency response, but many of those using the meter are not aware of its limitations. No major disadvantages are seen to a comprehensive program; the standards for such a program will have to insure that the attack-preparedness aspects of the program receive sufficient attention. Advantages would include improvement in the stature and quality of the RADEF personnel; recruitment of new monitors and volunteers through the interest in peacetime response; increased readiness due to more frequent drills, exercises, and responses to emergency situations; and better communication and coordination with the other radiation protection professionals within the state.

THE APPLICATION OF THE RADIOLOGICAL DEFENSE CAPABILITIES TO PEACETIME RADIOLOGICAL INCIDENTS

1. INTRODUCTION

1.1. PURPOSE AND METHODOLOGY

Two parallel systems, one geared for response to radiological accidents in peacetime, and the other, for response in the event of a nuclear war, have developed in this country. There has been some overlap between them, although this has taken place generally without formal guidance. Now, with the advent of an integrated emergency management philosophy within the Federal Emergency Management Agency (FEMA), the application of the wartime radiological defense (RADEF) system capabilities for peacetime response is being closely studied. The purpose of this paper is to discuss the applicability of the nuclear attack components of the RADEF system, including organizational structures, training, instrumentation, and subsystem capabilities to peacetime incidents, and to propose some actions necessary so that the RADEF support system can encompass all radiological hazards.

Information was gathered through review of pertinent literature from FEMA and its predecessor, the Defense Civil Preparedness Agency, and through telephone and personal interviews with emergency management officials in ten states and directors of state radiological health and/or environmental quality departments in nine states. State and local Radiological Defense Officers (RDOs) in these states were contacted when possible. Because the result was to be a concept paper, the states selected do not necessarily represent a valid sample. The states chosen, however, represent a variety of sizes, geographic locations, population densities, and experience with nuclear power plants and other fixed nuclear facilities. Some are NRC agreement states and, thus, have regulatory authority over some radioactive materials. Some of the states have a range of resources available for emergency radiological response; others have almost none. The state

personnel contacted were promised anonymity in order to encourage free expression of their opinions, and no states are identified in the text.

Discussions were also held with the FEMA National Emergency Training Center at Emmittsburg, Maryland, with people from two FEMA regional offices, and a few FEMA headquarters staff members. Similar conversations were held with other people working in the emergency response area, including representatives of radiation protection groups, federal agencies, and private organizations.

1.2 BACKGROUND INFORMATION

Radiological defense (RADEF) programs were developed to save lives, minimize radiation injury, and reduce property losses due to radioactive fallout resulting from a nuclear attack on the United States. RADEF is an integral part of the civil defense programs designed to enable the nation and many of its people to survive a nuclear attack. The RADEF programs at the national, regional, state, and local level have developed systems to meet this objective.

A RADEF system includes an emergency response capability or group of capabilities with a common mission. The capabilities generally include detection and measurement of radiation, evaluation of radiological hazards, and recommendation of appropriate countermeasures.[1]

In the years since the atomic weapon explosions of World War II, radioactive materials have found peacetime application in power generation, medicine, and industry. The proliferation of these uses has increased the probability of incidents involving radiation. Planning for response to these incidents has received new emphasis. Detailed emergency plans at both the state and local level are necessary in order for commercial power plants to receive or maintain their operating licenses. Planning guidance is being developed for areas surrounding federal nuclear facilities. Transportation accidents involving radioactive materials pose a frequent response problem. The question naturally arises as to whether some response capabilities might be applied to both peacetime and nuclear attack radiological preparedness.

The Federal Emergency Management Agency has recently decided that response to both natural and technological hazards and the response required in the event of a nuclear attack have many elements in common. Instead of developing a series of specific plans for the management of different types of emergency situations, FEMA is emphasizing the common capabilities that increase readiness for any kind of emergency. The implementation strategy for this approach is known as the Integrated Emergency Management System (IEMS). IEMS is to be implemented beginning in FY-1984.[2]

While it is quite feasible to combine many aspects of emergency management, integrating the peacetime and nuclear attack radiological response systems and capabilities may present some problems, although many states have already begun the process. Money given to the states for nuclear attack preparedness has been traditionally limited to that one use. The Federal Civil Defense Act of 1950, as amended in 1980 and 1981, allows the funds and resources for attack preparedness to be used in preparing for peacetime disasters to the extent that such use contributes to and does not detract from attack preparedness.[2]

Prior to the announcement of FEMA's strategy for integrated management of all types of emergencies, there was increased emphasis within many states for such an approach. The planning has been, at times, delegated to one agency, such as a combined civil defense/ disaster preparedness group, with the specialized response capability coming from other appropriate state agencies. As the need to handle radiological incidents at the state and local level became necessary, the responsibility for doing so was frequently assigned to an agency or department which was not the office responsible for attack preparedness or other areas of emergency management. These organizational decisions were made at the state level without any uniform national guidance. The development of state and local radiological emergency plans, especially for nuclear power plants, has further defined the roles of state agencies during radiological emergency response. Consequently, in the fifty states, there may be fifty different organizational arrangements for planning and response to peacetime nuclear accidents.

2. NUCLEAR ATTACK AND PEACETIME RADIATION RESPONSE ENVIRONMENTS

The radiation hazard that would result from a nuclear attack is difficult to compare with that which might occur in even a very serious peacetime incident. There would be enormous destruction in the areas that were attacked. A large fraction of the nation's population would be in areas where shelter against the radiation from fallout would be necessary in order to prevent deaths from radiation sickness. An attack would be a national disaster of such great magnitude that the affected areas could count on little assistance from federal resources or other parts of the country. The most serious radiological hazard would be the energetic gamma radiation from fallout. Some attention might be given to beta radiation to prevent beta burns. The emphasis for RADEF would be on preventing early deaths.

A single nuclear weapon detonation would produce similar fallout problems if it were surface-detonated. This type of incident might occur as the result of a terrorist action, an accidental detonation, or a show of force designed to produce compliance.[3] The immediate emphasis would still be on saving lives, but there may be more flexibility in the response and more ways to reduce radiation exposure. The principal difference here would be the limited area of damage. Assistance might be expected from outside the area, and people could be relocated from the affected area at some appropriate time.

In peacetime, accidents can occur at fixed nuclear facilities. The most prominent of these facilities are commercial nuclear power reactors. Accidents at reactors can range from trivial to possibly very serious, although the probability of the latter is very small. The greatest hazard from a reactor accident would be the release of a large portion of the material in the reactor core to the environment. If this occurred without any protective actions being taken, some early deaths due to radiation exposure might occur. A large area could be contaminated with fission products emitting beta and gamma radiation.

Possible consequences of accidents at other types of fixed nuclear facilities will vary widely depending on the nature of the facility. In general, the radiation hazard would never approach that of even a small

nuclear detonation. Inhalation and ingestion of contamination may present a larger hazard than external exposure. Because the facilities are fixed, the possible hazards in the event of an accident can be determined in advance. The responding group should have some idea of what kinds of hazards to expect. Exposure will be controlled to prevent early deaths or radiation sickness; circumstances may also allow dose reduction to lower the risk of cancer or any other chronic radiation effects.

A response to transportation accidents is more difficult to plan. Transportation accidents can occur anywhere and involve many kinds of materials. One of the most highly radioactive materials transported is spent nuclear fuel rods from reactors. These materials, however, are shipped in such secure packaging that it is highly unlikely that any of the contents would leak during an accident. If there were large leaks, the radiation hazard around the accident could be severe. An accident involving some radioactive materials may also present a chemical or fire hazard. For example, the toxicity of uranium hexafluoride is more hazardous than the radioactivity of the uranium.[4] Many radioactive materials shipped will present only a minor hazard. In any case, the effects of a transportation accident would be very localized.

Accidents involving nuclear weapons, but not a nuclear detonation, present a different kind of threat. Most of these accidents would probably occur while the weapon is being transported. If the high explosive in the weapon detonates during the accident, small particles of radioactive weapons material may present an inhalation hazard, and the radioactive contamination may be spread over a larger area. The greatest potential problem is contamination of a large area with material that emits primarily alpha radiation.

Other types of radiation accidents are possible. The reentry of nuclear-powered satellites has caused a threat in recent years. The crash of one of these small reactors could cause high radiation levels in the immediate area. Peacetime accidents, then, may differ from nuclear attack in the degree and type of radiation hazard they produce and the size of the area affected by the incident.

3. EMERGENCY RESPONSE ASSISTANCE

3.1 RESPONSE TO RADIOLOGICAL HAZARDS FROM NUCLEAR ATTACK

The RADEF program is the established method for dealing with the possibility of radiation from nuclear war. This program is planned and operated under one clearly-defined office and director within each state; the placement of the RADEF organization within the state bureaucracy, however, differs from state to state.

A complete RADEF system should include the following capabilities: (1) a shelter radiological monitoring capability, (2) a radiological monitoring capability for emergency workers (formerly called self-protection radiological monitoring), (3) a monitoring and assessment capability, and (4) a radiological decontamination capability.[1] The shelter monitoring capability is intended to provide the people in public shelters with a way to detect, measure, and assess the radiological hazard from fallout. The primary resources of this capability are instrument sets containing high-range survey meters and dosimeters; the instruments are calibrated and maintained by the states. Training and instructional materials are also available. The monitoring capability for emergency workers will allow emergency services personnel and those in vital jobs to monitor and control their own exposure to radiation. Because of the number of people in these positions, there are numerous instrument sets distributed throughout the country, and many people have received some training on their use in an attack environment. The monitoring and assessment capability is intended to provide trained assessment personnel for the Emergency Operating Center, a method for reporting radiation levels at different places, and at the state level, aerial radiological monitoring. Current plans call for information on radiation levels to be supplied by those in the shelters or by emergency services personnel. Again, instruments and trained people are available, but the quantities are not sufficient. The radiological decontamination capability includes countermeasures that might be used to reduce the exposure to radiation from fallout.

Monitoring instruments, heavy equipment, and trained people are also important in this effort. The RADEF program puts emphasis on training and equipping local, state, and federal government employees, as well as selected volunteers, for the wartime response roles.

3.2 PEACETIME RESPONSE TO RADIOLOGICAL HAZARDS

The local response does not have to be as self-sufficient in dealing with a peacetime radiological incident as it would in the case of a nuclear attack. When the effect of an incident is confined to a small area, resources outside that area can be brought in for assistance. In most cases, there is a state agency, such as a department of radiological health or environmental quality, responsible for protecting the public from radiation hazards. These people can usually respond in a few hours and bring specialized equipment that is not available on the local level. However, the initial identification of the hazard by the first responder, especially in the case of transportation accidents, remains an important task requiring some training.

The organized response within states to peacetime radiological accidents takes many forms, and the RADEF-trained personnel and civil defense equipment already in place play a major role in some of them. The degree to which the state and local agencies now cooperate with the RADEF program in responding to peacetime accidents depends in part on the resources of the state, the type of training the Radiological Defense Officer (RDO) has had, and the confidence the other agencies have in the competence of the local RADEF radiological monitors.

In at least one state, the Department of Radiological Health is responsible for all radiological response, and the state RDO is a member of the response team. That state's training courses are adapted to include both peacetime and wartime applications. The RADEF equipment is being supplemented by the state to prepare the state for an integrated response to all types of radiological accidents or nuclear war.

In other states, although the overall planning for peacetime radiological emergencies comes from offices in the same state agency as

the RADEF program (usually civil defense or disaster preparedness), the peacetime radiological response is carried out by other agencies concerned with radiological health or the environment. In some of these states, the state professional staff responsible for mitigating the effects of the accident discourages the local government's use of civil defense trained monitors and civil defense instruments on the grounds of insufficient training, inadequate sensitivity of the equipment, and lack of practice. On the contrary, other state radiological health personnel find the local staff to be "good eyes and ears" and very useful in determining whether or not there is a problem, contacting the proper agencies for advice, and securing the area until technically qualified personnel arrive. State RADEF and other radiological response personnel have found that interest is much greater in peacetime response than in preparing for war. People with a dual mission seem better able to maintain their skill and interest levels.

A large peacetime incident, such as a serious power plant accident or weapons accident, would soon exhaust the present response capabilities of most states. Few states have the technical personnel necessary to carry on a sustained field response in a radiological incident. The federal government, however, has resources for dealing with radiological problems. These resources are available on request to the states under the Federal Radiological Emergency Response Plan (FRERP).[5]

FRERP provides a means for making Federal assistance available for any type of peacetime radiological accident. The FRERP contains information specifically on Federal radiological monitoring and assessment assistance. This section, called the Federal Radiological Monitoring and Assessment Plan (FRMAP) describes how such assistance will be coordinated in support of the state and local governments. FRMAP assistance may range from advice over the telephone to a large-scale field response. Specialized radiation detection equipment, trained personnel, and support systems can be provided. The Departments of

Energy, Agriculture, Commerce, Defense, Health and Human Services, and the Interior, as well as the Environmental Protection Agency, Federal Emergency Management Agency, and the Nuclear Regulatory Commission, all participate in FRMAP.

4. REQUIREMENTS FOR A UNIFIED RADEF SYSTEM

4.1 INSTITUTIONAL CONSIDERATIONS

The 1980 and 1981 amendments to the Federal Civil Defense Act give the Federal Emergency Management Agency statutory response responsibilities in peacetime. There is a need to communicate this charter for broadening peacetime activities clearly to state, local, and RADEF officials. The responsibilities and authority of RADEF in peacetime must be specified; and the wartime responsibilities, such as weapons effects reporting and sheltering, must be redefined in line with current civil defense planning.

In the development of state peacetime radiological response plans, a number of factors have influenced the way state responses are patterned. These include the size of the state, the presence of nuclear power plants or other fixed nuclear facilities, the state resources available, long-standing interagency or intergovernmental responsibilities, authorities, and traditions, and whether or not a state is an NRC agreement state. These factors also affect the speed with which states change their organizational response as a result of shifting policies in federal agencies.

The use of the state Radiological Defense Officer (RDO) for peacetime response may not always be acceptable at the state level. Each state supervises the work and activities of the RDO, including the assignment of work priorities.[6] FEMA will find it difficult to specify a position for the RDO in the peacetime response of each state. Assignment of the responsibility for emergency response and technical management of incidents involving radiation has already taken place in most states, frequently with the agreement of the Nuclear Regulatory Commission. These assignments may have been codified in state law, accepted in state planning documents, or clarified by legal rulings. Changes in the function of RDOs and RADEF will have to be made cautiously to avoid disrupting the sometimes fragile relationships between state agencies sharing the responsibility for the response.

The availability for peacetime response of the state RDO, local RDOs, and other responders using civil defense instruments must be spelled out clearly by FEMA. Each state decides on the role, if any, these persons will play in a peacetime radiological response. This could be done through comprehensive state radiological emergency plans, by state law, or by memoranda of agreement among the various agencies involved. Agreements should be followed by procedures to insure that the appropriate people are notified when incidents are reported. One state radiological health department, for example, complained that the state emergency management division would occasionally decide to handle a call involving radiation without notifying or involving the radiological health department, which had the responsibility for the response. In another state, local RADEF-trained first responders and the local government sometimes fail to contact state technical experts and instead handle the emergency themselves. If one agency is the technical expert and another is the emergency coordinator, some agreement must be reached on when a state of emergency ends and who may continue supervising the recovery afterward.

When an RDO becomes involved in emergency radiological response during peacetime, some changes in his or her operational chain of command with FEMA and the state agencies may be expected. If the RDO and other RADEF personnel are providing technical radiological assistance during a large peacetime accident, they may be interacting with the other state and federal agencies that have radiological monitoring and assessment responsibilities and reporting through the state/federal assessment center instead of through the FEMA/state center concerned with overall coordination. An RDO responding to an incident may need authority to get needed technical information directly from federal agencies other than FEMA.

Another question that may have to be resolved on the state level is that of liability. What happens if a local RDO or a RADEF-trained responder takes the responsibility for decision-making at an incident and makes the wrong decision? Some states may have already provided

legal protection for employees carrying out job-related functions. "Good Samaritan" laws could provide similar coverage for volunteer responders.

4.2 APPLICATION OF THE CURRENT RADEF CAPABILITIES

4.2.1 The RADEF System Components

In the discussion of the current RADEF system, four types of capabilities are mentioned: (1) a shelter radiological monitoring capability, (2) a radiological monitoring capability for emergency workers, (3) a monitoring and assessment capability, and (4) a radiological decontamination capability. The major assets of these capabilities are radiological instruments, training programs, and people. The instruments and training will be examined in more detail later. What aspects of these capabilities might have application in peacetime emergencies?

4.2.2 Application of the RADEF Organization

The civil defense and disaster preparedness organizations, both on the state and local level, have generally now been merged into a single disaster preparedness group. The RDO (who may have assistants) is an important member of this organization and may already have peacetime duties, as do many local radiological monitors (RMs). Table I describes in general terms the present responsibilities of the RADEF system personnel and suggests functions they could perform (or are currently carrying out) in a peacetime response situation. The degree to which RADEF personnel participate in the response depends on the state's willingness to accept the use of these resources. Because the job titles currently being used have, at times, led to confusion between state and local personnel and are not descriptive of an integrated response, new names for some of the positions are suggested.

Most of the states contacted are quite satisfied with their own organizational arrangement, leading to the conclusion that a variety of bureaucratic arrangements can work. A key interface in peacetime response utilizing the RADEF capabilities is between the RDO and the

TABLE 1

Possible Functions for RADEF Personnel in Integrated Radiological Response

Position (alternate title in parenthesis)	Wartime Function (CPG 2-6.2)	Peacetime Functions (as desired by state and/or local government)
State Radiological Defense Officer (State Radiological Defense/Response Officer)	Works with state civil defense/disaster preparedness organizations	Coordinates actions with state agency responsible for radiological response
	Manages state RADEF program	Arranges for training of local monitors or first responders (with state input)
	Has responsibility for policy recommendations for radiological defense	
	Evaluates probable effects of reported radiation	Cooperates in exercising system
	Recommends appropriate protective action measures	Assists in state radiological emergency response
	Arranges for recruitment and training of personnel (local RDOs, monitors, etc.)	
	Cooperates in exercising system	
Local Radiological Defense Officer (Radiological Defense/Response Coordinator	Works with or is civil defense director	Works with or is disaster preparedness director
	Assumes responsibility for policy recommendations for local radiological defense	Helps with recruitment and training of personnel for dual role
	Helps evaluate probable effects of reported radiation	Participates in exercising system
	Recommends appropriate protective action measures	Participates in state/local radiological response
	Helps with the recruitment and training of local personnel	Cooperates in identification and possible stocking of appropriate shelters for peacetime incidents
	Cooperates in exercising system	

TABLE I (continued)

Position (alternate title in parenthesis)	Wartime Function (CPG 2-6.2)	Peacetime Functions (as desired by state and/or local government)
Local Radiological Monitor	Detects, records, and reports radiation exposures and rates in shelters and in the field Serves as contamination monitor for evacuees and shelter operators Controls radiation exposure during decontamination	In "first responder" role, determines whether or not there is a radiological hazard; if so, secures the area and contacts appropriate authorities Serves as monitor or monitoring assistant to state/local field teams to supplement field monitoring personnel Serves as contamination monitor for evacuees and shelter operators Controls radiation exposure during decontamination
Analyst	Prepares collected data in usable form Estimates future exposure rates	Assists in state/local response as part of analytical team
Plotter	Records incoming data	Assists state/local response as part of recording team
Aerial Monitor	Provides aerial radiological monitoring capability	Provides aerial radiological monitoring capability Provides air courier service for personnel or laboratory samples Provides non-radiological aerial monitoring capability (traffic, etc.)

radiological health department; this interface is affected by the professional background and training of the RDO and the personal relationships among the technically-trained radiological personnel. These personal relationships are most important in improving the ability to work together in an emergency when the RDO is a member of the disaster preparedness agency and does not have a close daily working relationship with the other radiological response organizations. State RDOs come from a variety of backgrounds, often from the military services, and some have less radiological training than the members of the state radiological health department. Frequent interaction and mutual trust will be critical to an integrated response.

If the RDO is located in a state radiological health or environmental quality department, the integration of the peacetime response with the nuclear attack response may be more thorough. But unless close contact is kept with others involved in the state civil defense or emergency planning, those vital relationships necessary in the event of a nuclear attack could be lost or diminished.

4.2.3 Shelter Monitoring

A shelter that provides protection against radioactive fallout from a nuclear attack will also protect against radiation from many peacetime radiological accidents. The shelters posted under the Community Shelter Program were chosen on the basis of location and degree of protection against radiation. Some shelters identified in host areas under the Population Protection Program might serve as congregate care facilities if an evacuation were part of the emergency response. In peacetime, however, one could be more selective in choosing shelters, avoiding areas likely to be in the path of any release of radioactive materials. Shelters chosen for protection against radiation from fallout particles will not necessarily provide protection against the infiltration of a radioactive gas from a peacetime incident.

Instruments could be used in congregate care centers to check people (on arrival) for radioactive contamination. However, the survey meters now found in the shelter instrument sets would not be of much use in this function because their range is too high. Furthermore, most

shelter instruments are stored in bulk repositories, not at the shelters, with plans for distribution during a period of increased readiness for a nuclear attack. Likewise, the dosimeters intended for exposure control of the shelter residents after a nuclear attack would have a high range and would not be suitable for use for the lower exposures expected following a peacetime incident.

4.2.4 Radiological Monitoring for Emergency Workers

The radiological monitoring capability for emergency workers is broader than the shelter monitoring capability and is, therefore, more adaptable for use in a non-attack situation. Many of the people trained as monitors in vital industries, agencies, and emergency services are the same people who would respond in the event of a peacetime accident. These might include transportation accidents, accidents at fixed nuclear facilities, or some weapons accidents. In some states, instruments already have been assigned to these monitors and, therefore, are already widely distributed. Although dosimeters have been distributed with the survey instruments, the range of exposures they measure may be too high for meaningful use in accident response (unless, of course, the gamma radiation levels are very high). In some states, the lower-range training dosimeters have been assigned to emergency service personnel located near nuclear power plants.

The monitoring capability for emergency workers has already been incorporated into the state radiological response in many states. Emergency service workers are being taught to read shipping papers and recognize the placards used in shipment of radioactive material. Sometimes their only radiological responsibility is to notify the appropriate state agency; in other states they may use their low-range survey meter to determine whether or not a hazard exists. If the instruments indicate radiation levels greater than the normal background, they secure the area and call the proper state agency. Radiological monitoring roles have already been defined for emergency workers in regard to accidents at fixed nuclear facilities within some states.

4.2.5 Monitoring and Assessment

The radiological monitoring and assessment capability was developed to provide enough information on the radiation environment to decision-makers at the Emergency Operating Center. It was intended to be one of the broadest capabilities, but some aspects are now being reconsidered. The Emergency Operating Center, however, would also function as an operations or coordination center during peacetime accidents that require a large response. This dual use is already typical at the state and local level.

The RADEF staff trained for radiological assessment after a nuclear attack could apply their skills to large peacetime radiological problems if they were given additional training and instruments. Plume-tracking and decision-making after a peacetime accident will require separate techniques and a different perspective on radiation exposure. Computer programs may already be set up for some of the peacetime assessment procedures, particularly in the case of incidents at nuclear power plants. Of course, the assessment function in non-attack situations may already be assigned to another branch of the state government; any assistance RADEF can provide would have to be worked out on a state-by-state basis.

The concept of the weapons effects reporting system is currently undergoing revision. Previously, a series of monitoring locations had been chosen on a geographical basis to provide a representative picture of the fallout radiation levels. Reports of radiation levels will now come from the people in fallout shelters and emergency service personnel. If lower-range instruments were assigned to trained monitors at predetermined locations near fixed nuclear facilities, they might be able to serve a useful early reporting function during peacetime incidents at those locations. They might detect higher radiation levels beyond the facility boundary before the state field monitors reach the site. The obvious sensitivity of this kind of function would require that these people be carefully selected and exercised.

The communications associated with the wartime response and radiation reporting could also be used in a peacetime emergency; the

degree to which they are applicable may not be clear until the plans for a reporting system are better defined. In an integrated system, reporting functions could conceivably be merged with other disaster reporting systems. If an integrated disaster reporting system is chosen, arrangements would have to be made to insure the efficient reporting of radiological data. Problems could arise if the data could not get transmission priority on the network or if radiological measurements were garbled as a result of transmission by people who are not familiar with the units and terminology.

Another useful capability is that of aerial radiological monitoring. Arrangements have been made in many states for the Civil Air Patrol (CAP) to monitor fallout in the event of a nuclear detonation. The instruments developed for aerial monitoring of a postattack environment are designed to read higher radiation levels than those expected in most radiological incidents. They might be useful in the event of a detonation of a single weapon or the crash of a reactor-powered satellite. These events would be of such importance, however, that outside resources would probably be summoned to do this type of monitoring. The planes and trained people could be of use at other times, however. Aerial monitors have also been trained with the standard radiation monitoring course. Some states have plans for using the CAP in non-radiological ways during a peacetime emergency. Members of the CAP might be called upon to survey the traffic arteries during evacuation or to transport samples from the accident site to a laboratory. As part of their mission to search for downed aircraft, some CAP units have received some military training for approaching a downed plane that might be carrying nuclear weapons.

4.2.6 Radiological Decontamination and Countermeasures Capability

The radiological decontamination and countermeasures capability could also be applied to some kinds of peacetime accidents. Transportation accidents, particulate releases from nuclear facilities, or weapons accidents could contaminate the environment with radioactive materials. The contamination might cover a small area around the site of a transportation accident or be blown across a larger area by a

chemical explosion during a weapons accident or accident at a nuclear facility.

Decontamination is required in a postattack environment to allow earlier use of essential facilities and to reduce the exposure to people working in vital facilities or industries.[1] Decontamination after a peacetime incident would have similar goals, but with additional emphasis on reducing the exposure of the public to radiation and on returning land and buildings to normal use as soon as possible.

Increased emphasis on decontamination and countermeasures would improve the attack preparedness, also. Our discussions with the states suggest that very little information about decontamination and countermeasures is being currently given in the civil defense courses. The general information and concepts of postattack decontamination are applicable to peacetime situations. The principal differences in peacetime would be acceptable levels for contamination and restrictions on disposal of the contaminated material. Whether the civil defense instruments would be useful for this task will depend on the type of radiation and the level of contamination.

Possible applications of decontamination and other RADEF capabilities are summarized in Table II.

4.3 APPLICATION OF THE RADEF INSTRUMENTS

The RADEF program has procured and granted to the states for civil defense use a large number of radiation monitoring devices located throughout the country. The most common of these are the CD V-715, an ionization chamber with a maximum range of 500 R/hr, the CD V-700, a Geiger-Mueller counter with a maximum range of 50 mR/hr, and two self-reading, pocket, ionization chamber dosimeters, the CD V-742 and CD V-138. The CD V-717 has the same range characteristics as the CD V-715, but has remote detection capability (the ion chamber can be physically separated from the meter and read through a connecting cable). The CD V-742 has a maximum reading of 200 R, while the lower range CD V-138 has a maximum reading of 200 mR. The shelter monitoring sets contain the CD V-715, several CD V-742 dosimeters, and a CD V-750 dosimeter charger. Instrument sets for emergency service workers contain the CD V-700 in

TABLE II

Possible Applications of RADEF Capabilities to Peacetime Radiological Accidents

	Peacetime Radiological Accidents			
RADEF Capabilities	Fixed Nuclear Facilities	Transportation	Nuclear Weapons	Other
Shelter Monitoring	Some shelters might serve as congregate care centers for evacuees Little application for shelter instrument sets Trained monitors	Some shelters might serve as congregate care facilities for evacuees Little application for shelter instrument sets Trained monitors	Trained monitors	Trained monitors Possible application of shelter instruments in high gamma radiation fields
Radiological Monitoring for Emergency Workers	Trained monitors (normally emergency service workers) Dispersed instruments including CD V-700 and sometimes low-range dosimeters	Trained monitors (normally emergency service workers) Dispersed instrument sets including CD V-700	Trained monitors (normally emergency service workers) Modified or non-standard instruments with alpha capability may be of some use	Trained monitors (normally emergency service workers) Dispersed instrument sets including both CD V-715 and CD V-700

(Continued)

Table II
(Continued)

	Peacetime Radiological Accidents			
RADEF Capabilities	Fixed Nuclear Facilities	Transportation	Nuclear Weapons	Other
Monitoring and Assessment	Trained monitors and personnel to assist in data analysis and assessment	Trained monitors	Trained monitors	Trained monitors
		Access to communications systems	Access to communi- systems	Access to communi- systems
	Resources of Emergency Operating Center	Limited Use of CD V-700 survey meter	Aerial survey for accident in- volving downed plane	Analytical assistance
	Access to communications	Aerial survey of remote accident sites or traffic flow, aerial courier service		
	Limited use of CD V-700 survey meter			
	Aerial survey of traffic flow or courier service			
Radiological Decontamination and Counter- measures	Personnel trained in decontamination and counter- measures	Personnel trained in decontamination and counter- measures	Personnel trained in decon- tamination and counter- measures	Personnel trained in decontamination and counter- measures

addition to the CD V-715 ion chamber, dosimeters, and charger. The recommended composition of the RADEF instrument sets is shown in Table III. In addition to the instruments, a maintenance and calibration capability has been established for each state to maintain and service each instrument on a regular schedule.

These instruments, of course, were designed for use in an emergency resulting from a nuclear attack. Their detection capability was tailored to the expected hazard. They are intended primarily for detecting and measuring gamma radiation at postattack levels; the lowest range on the CD V-715 reads 500 mR/hr full-scale. The CD V-700 can also detect very energetic beta radiation. The lowest scale on the CD V-700 reads 0.5 mR/hr.[4] It was designed primarily as a training instrument,[7] although it might be used in peacetime accidents and decontamination and recovery operations if the radiation background is not too high. The response of both survey meters is very dependent on the type, energy, and quantity of radiation present. None of the instruments have the capacity to detect alpha radiation or airborne contamination.[3] However, both these capabilities could be important in a peacetime incident.

The civil defense instruments must be used by someone with at least a minimum of training. Disregard of zero adjustment on the CD V-715 or the possible saturation of the CD V-700 in high radiation fields can lead to incorrect readings. Some care is also required to multiply the scale reading by the proper multiplier to get the measured exposure rate. The dosimeters should be charged before use and at regular intervals when they are not being used.

The CD V-715 and the CD V-742 are designed for such high levels of radiation that they will find limited use in a peacetime emergency. The CD V-700 may prove useful if the limitations of the instrument are understood. A well-calibrated CD V-700 will respond correctly to gamma radiation of sufficient energy. It can detect energetic beta radiation, but it might not necessarily reflect the degree of the hazard. It is not suitable for very low energy gamma, beta, or alpha monitoring.[7] The CD V-138 dosimeter may be useful for personal exposure control when responding to a peacetime radiological incident.

TABLE III

Recommended Composition of RADEF Instrument Sets (1978)

	Quantity and Type of Instruments in Set				
Set Type	CD V-700	CD V-715	CD V-717	CD V-742	CD V-750
CD V-777[a]	1	2[b]	0	6	1
CD V-777A[c]	1	1	1	6	1
CD V-777-1[d]	1	1	0	6	1
CD V-777-2[e]	0	1	0	6	1

[a] Standard set recommended for emergency workers.

[b] Some 777 sets may have one CD V-715 and one CD V-720.

[c] Standard set for surface monitoring.

[d] Alternative set for emergency workers.

[e] Standard set recommended for public shelters.

Source: Adapted from Radiological Defense Preparedness, CPC 2-6.1, Defense Civil Preparedness Agency, Washington, DC, April, 1978.

Because the current RADEF instruments will continue to be used for peacetime response, some changes in training and procedure are necessary to improve their utility. The CD V-700s should be routinely serviced and calibrated. The monitors should be taught the appropriate use of the instrument in peacetime and should practice frequently to become familiar with natural background readings on the meter. The state technical agency responsible for handling radiological hazards should also become more familiar with the civil defense instruments so it can better interpret the emergency calls received from first responders using these instruments and, perhaps, resolve problems in interpreting the meter readings over the telephone.

Although they were designed to be sturdy, the instrument sets that will be moved frequently or those that are being carried daily in emergency service vehicles should have some protective packaging. Cushioned carrying cases with room for the instruments and instruction manuals, standard operating procedures for response, and lists of people to contact are recommended. Care should be taken in the design of these cases -- they should not be made so attractive that other uses would be found for them.

With the movement toward peacetime as well as nuclear attack use of RADEF instrumentation, more flexible instruments and a greater variety of instruments would be desirable. Some emergency response people feel that they already need some alpha detection capability. Others have expressed an interest in tissue-equivalent detectors and air-sampling equipment. Those who have obtained the modified CD V-700 with the thin window have mixed feelings about its usefulness.

In at least one state, the maintenance shops for RADEF and other radiological survey instruments have been combined. Because the other state agencies usually have different kinds (and higher quality) instruments, additional training and calibration equipment may be necessary for the state RADEF maintenance and calibration shops before they can expand their service.

Exposure control and the instruments to accomplish it will require more emphasis on a peacetime response. As a minimum, a larger number of low-range dosimeters will be necessary. States that have redistributed their supply of CD V-138s to the area around nuclear facilities may have left those responding to transportation accidents elsewhere without a useful means of recording any exposure to radiation. Those participating in a peacetime radiological response should be informed about their possible exposure to radiation to assure that any risk they are assuming is voluntary. The time may be approaching when it is necessary to be able to prove that no exposure was received or to measure any exposure more precisely. Consideration might be given to obtaining thermoluminescent dosimeters (TLDs) for those emergency service or RADEF personnel likely to be involved in emergency radiological response. Sometimes utilities provide this service near their power plants. Because of the expense involved in setting up such a personnel monitoring system and the infrequency with which most of the TLDs assigned to emergency personnel would need to be read, this might be an ideal service to integrate with the state technical agency responsible for radiological health.

When new survey instruments are developed for the civil defense program, it would be desirable for each instrument to have a wider range of detection. If the same instruments could serve in both peacetime accidents and in a postattack environment, the people using the instruments would get more experience in radiation measurement. The peacetime experience would be very valuable in a fallout environment. These instruments would have to be sturdy and reliable. While gamma radiation would present the greatest threat to the public in a fallout environment, greater sensitivity to beta radiation would be useful for activities in the recovery period.

4.4 APPLICATION AND MODIFICATION OF TRAINING PROGRAMS

The training of many of the people necessary to implement the current state radiological emergency plans has been based on a combination of FEMA and state programs. In some cases, the basic RADEF RDO

and monitoring courses and RADEF instruments are the only resources available to the state. People trained in this manner supplement a small state radiological health department which may only have inspection duties. In other states, additional training and training materials applicable to specific radiological problems anticipated within the state have been or are being developed by the RDOs, state agencies, or through collaborative efforts.

The RADEF training courses currently in use have provided training for wartime response to a large number of people throughout the country. This training includes self-study and short practical courses for radiation monitors who would report weapons effects and for emergency workers. Many of these people, especially police and fire personnel, are the first to arrive at the scene of peacetime accidents and now use their training to determine whether or not there is a radiological hazard. The RDOs are given broader training to prepare them for planning, assessment, and training tasks. Although the RADEF courses are war-response oriented, many RDOs believe the carry-over into peacetime work is large. The better their general understanding of radiation and its effects, the more useful they can be when dealing with any radiological hazard. With this in mind, some RDOs are getting additional health physics training.

The training needed for peacetime response may vary with the type of radiological incident. In transportation accidents, the first people on the scene generally need to be able to determine whether a radiological hazard exists. Subsequent actions are usually taken by more highly trained personnel. Nuclear power accidents may require monitoring teams for the area around the plant site, as well as people to assess the radiological hazard. Training for the RADEF people who participate in these activities will need to be more extensive than that needed by police and firefighters who are asked to determine a "go" or "no go" situation. While a weapons accident may really be a transportation accident, one would expect an early and large federal response. The amount of involvement of the RADEF personnel in peacetime

response, and consequently, the type of training he or she should receive, should be decided in cooperation with the state agencies and local governments responsible for the response. RADEF-trained responders will not, in general, be performing the most technically demanding response tasks. FEMA, however, should provide training courses, materials, and equipment, for RADEF and non-RADEF personnel, to help the states improve their peacetime response and broaden the civil defense capabilities at the same time. The FEMA RADEF training courses are currently being revised. Material on response to peacetime radiological accidents as well as nuclear attack will be included in the training of RDOs and radiological monitors.

In comments from state and local RDOs and radiological health personnel, the following points were emphasized:

(1) Because interest is much greater in training for peacetime response than for war, peacetime courses can be used as an incentive to prepare people for a dual role.

(2) Simple, sturdy, reliable instruments that measure a variety of levels and types of radiation for use during training and response would be a great asset. Training without having adequate instruments for actual use is not effective.

(3) An adequate supply of personal dosimeters and training in their use would be an advantage, especially in states that may respond to accidents at nuclear power plants.

Specific training courses or modules were also suggested. These included the following:

(1) More general health physics training for the RDOs and their staffs;

(2) Expanded basic training course for first responders which would include general information on radiation and monitoring techniques for fallout and peacetime releases;

(3) Specialized training for duties as monitoring assistants, contamination monitors, and data assessment assistants in areas around nuclear power plants;

(4) Basic background course on radiation and its effects for public officials and others, such as the Red Cross shelter managers, who will be dealing with the public during a radiological crisis of any origin;

(5) Advanced training courses for the state RDO, with the addition of more basic health physics, decontamination, and emergency response training; and

(6) Advanced radiological training for selected responders and for instructors who would be teaching the integrated response courses.

Many of the people contacted emphasized the need for better trained response people, even if this meant that fewer people were trained. There is a great fear of the political and health effects if an inadequately trained responder mishandles the initial response. This concern is particularly strong among the agencies that have the legal responsibility for protecting the public from radiological hazards. They perceive a need for certifying responders in some way.

Training and interest will be difficult to sustain if there is never an opportunity to apply the training. First responders, in particular, may go for years before encountering a transportation accident involving radiation. They will require periodic refresher courses. Their interest may be sustained by participation in exercises. They should also be encouraged to use their instruments periodically if only to become familiar with the fluctuations in background radiation in their area.

There is a shortage of qualified instructors in some states now, much less those capable of doing the new training. Even if fewer people are trained to higher levels of competence, there is still a need in both peace and war for a large number of knowledgeable people

(trained and equipped) who are distributed throughout a wide geographic area.

The mystery of radiation and the fear it invokes will be easier to combat in a time of crisis if there are people in each community who have some understanding of radiation and its effects.

5. ADVANTAGES AND DISADVANTAGES OF A COMPREHENSIVE RADEF PROGRAM

Will integrating a peacetime radiological response capability with RADEF adversely affect preparedness for nuclear war?

Most RADEF and state radiological personnel who were contacted during the course of this study felt that integrating the peacetime and wartime response capabilities would strengthen both. Most government, emergency service, and volunteer personnel are far more interested in training for response to peacetime nuclear accidents. This interest might allow the RADEF program to recruit more qualified personnel and keep their training current through more frequent exercises and refresher courses. The basics of response in a postattack environment can be integrated into the training. Some RDOs have identified interested people through the peacetime training and guided them into local RDO positions. Although the exposure guidelines, techniques, and instruments are not the same in both situations, most people felt that the expanded training and increased general knowledge of radiation and its effects would strengthen rather than weaken the RADEF program. The peacetime applications, with their increased visibility, may also lead to a more professional status and an increased "pride in the job" for the RADEF personnel.

One of the major advantages of using RADEF in peacetime is that the radiation detection instruments are in the field and in daily use. When the instruments are used regularly, they are much more likely to be operating well and used correctly in the event of a nuclear attack. Even lower range instruments would be useful in a postattack environment if the radiation levels are not too high. Many states lack the personnel and equipment to handle major radiological incidents of any kind and would benefit from access to the RADEF resources.

Coordination among the different state agencies involved with radiological protection would probably improve due to more frequent interaction. The civil defense offices in many states have already

benefited from the increased contacts with different agencies and levels of government that have resulted from the emergency planning around nuclear power plants. Routine coordination procedures are a great advantage in a crisis.

There is some concern that the time involved in helping plan for or responding to peacetime accidents would limit the ability of the state RDO to plan for a wartime response. If the RDO is not located in the same agency as others preparing for different kinds of disasters, the overall response capability may be limited by less interaction. When the RDO is part of any state agency, what he or she does will be determined to some degree by the management of that agency. If the management assigns many peacetime duties, the attack preparedness activities could suffer. As long as FEMA controls the funding of those positions, it should be possible to specify the attack preparedness duties that must be done, but the independence of the state in regard to peacetime response must be maintained. Most RDOs contacted seemed to feel that the impact on their attack preparedness duties would be minimal. The peacetime activities were thought to lend stature and credibility to their primary role.

Changes in training, particularly increasing the level of training for fewer people, could result in fewer people in the field with even a rudimentary knowledge of radiation and radiation measurement. This might be offset by the advantage of having more people with advanced training available throughout the country who could train others, if needed, and make better radiological decisions under crisis conditions.

In conclusion, although the details of RADEF participation in peacetime radiological response are being and must be worked out at the state and local level, the advantages of integrating the RADEF resources into the peacetime response are believed to greatly outweigh the disadvantages.

6. CONCLUSIONS

The following conclusions have been reached as a result of this brief study:

(1) The RADEF program for wartime response should be reexamined and defined in light of current civil defense planning as the conversion to comprehensive radiological response is planned.

(2) FEMA should communicate, in addition to the attack preparedness and response functions and authorities, a clear charter for the peacetime application of the RADEF system which can be understood and implemented by the state organizations.

(3) The general structure of the RADEF program, its organization, personnel, and many of its components are applicable for peacetime response. Modifications are needed in training, equipment, and personnel titles. In fact, RADEF equipment and both professional and volunteer personnel are already being used for this purpose.

(4) Implementation of the nuclear attack components, with the supporting training and equipment requirements, should be required in all states. Greater flexibility is needed for peacetime radiological response systems because of varying state response requirements, organizations, and policies. Some states may choose to use none or only part of the RADEF resources.

(5) New training courses or training modules dealing with radiation and response to radiological incidents should be developed. Peacetime response information should be incorporated into the basic training course for radiological monitors and RDOs. Modules dealing with general information on radiation or special topics such as transportation accidents or accidents at nuclear power plants should be included.

(6) Additional, more flexible radiation detection instruments and personnel monitoring devices would greatly enhance the peacetime usefulness

of the RADEF system and provide for a stronger response under any circumstances. Adequate numbers of instruments and training in their proper use are necessary.

(7) A peacetime response role presents the opportunity for additional exercises and drills. These training measures, perhaps using FEMA-developed scenarios, would increase the level of preparedness for both war and peacetime response and help maintain the interest of the trained volunteers.

(8) No major disadvantages to the use of RADEF resources for peacetime response are seen. On the contrary, the additional cooperation between state agencies and response personnel and increased interest and willingness to participate in training, exercises, and accident response on the part of both professional staff and volunteers will enhance the program.

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